- depositing a first layer of SiO_2 on the surface of the piezoelectric layer opposite the rough surface, to a thickness of about 0.5 µm,

- carrying out a first chemical-mechanical polish (CMP) of the SiO_2 layer deposited on the rough surface; however, the roughness obtained following this polish remains too high for a good quality bond,

- depositing a second layer of SiO_2 on the surface of the piezoelectric layer opposite the rough surface, to a thickness of about 0.5 µm,

- carrying out a second chemical mechanical polish (CMP) of the SiO_2 layer deposited on the rough surface, until a sufficient roughness to allow bonding of good quality of the piezoelectric layer covered with the SiO_2 layer to the carrier substrate is obtained, said carrier substrate itself being covered with an SiO_2 layer requiring mechanical-chemical polishing (CMP).

Apart from the cost induced by the implementation of the aforementioned steps on the carrier substrate and on the piezoelectric layer, this process has the drawback of generating a significant curvature or bow of the substrate, this bow being due to the fact that the deposition of the SiO_2 layers on the piezoelectric substrate is carried out at high temperature. This bow disrupts the operations subsequently carried out on the substrate to fabricate the filter, which are meant to be carried out on flat substrates.

BRIEF DESCRIPTION OF THE INVENTION

One aim of the invention is to remedy the aforementioned drawbacks and in particular to provide a process for fabricating a substrate for a radiofrequency device having a lower cost and/or a lower bow compared to the prior-art process.

An aspect of the present invention provides a process for fabricating a substrate for a radiofrequency device by joining a piezoelectric layer to a carrier substrate by way of an electrically insulating layer, the piezoelectric layer having a rough surface having a roughness between 0.3 and 5 µm RMS at its interface with the electrically insulating layer, said process being characterized in that it comprises the following steps:

- providing a piezoelectric substrate having a rough surface having a roughness between 0.3 and 5 µm RMS suitable for reflecting a radiofrequency wave,

- depositing a dielectric layer on the rough surface of the piezoelectric substrate,

- providing a carrier substrate,

- depositing a photo-polymerizable adhesive layer on the carrier substrate,

- bonding the piezoelectric substrate to the carrier substrate by way of the dielectric layer and of the adhesive layer, in order to form an assembled substrate,

- irradiating the assembled substrate with a light flux in order to polymerize the adhesive layer, said adhesive layer and the dielectric layer together forming the electrically insulating layer.

- the photo-polymerizable adhesive layer is deposited by spin-coating;
- the bonding step is carried out at a temperature comprised between 20 and 50°C, and preferably between 20°C and 30°C;
- the light flux is applied through the piezoelectric substrate;
- irradiation is pulsed;
- the light flux has a wavelength comprised between 320 nm and 365 nm;
- the carrier substrate is made of a material possessing a coefficient of thermal expansion lower than that of the material from which the piezoelectric substrate is made;
- the carrier substrate is made of silicon, of sapphire, of polycrystalline aluminum nitride (AlN), or of gallium arsenide (GaAs);
- the process furthermore comprises, after the polymerization of the adhesive layer, a step of thinning the piezoelectric substrate so as to transfer, to the carrier substrate, a piezoelectric layer of a defined thickness;
- the thinning step comprises etching and/or chemical-mechanical polishing;
- the process comprises, after the thinning step, carrying out an anneal to smooth the piezoelectric layer;
- each step subsequent to the bonding is carried out at a temperature lower than or equal to 300°C;

Another aspect of the present invention provides a process for fabricating a radiofrequency filter, comprising:

- fabricating a substrate using the preceding fabrication process,
- forming a pair of interdigitated electrodes on the surface of the piezoelectric layer of said substrate.

Another aspect of the present invention provides a radiofrequency-device substrate comprising, in succession, a carrier substrate, an electrically insulating layer and a piezoelectric layer having, at its interface with the electrically insulating layer, a rough surface having a roughness between 0.3 and 5 μm RMS suitable for reflecting a radiofrequency wave, the electrically insulating layer comprising, in succession, from the carrier substrate to the piezoelectric layer, a polymerized adhesive layer and a dielectric layer.

Another aspect of the present invention provides a radiofrequency filter, comprising a substrate such as described above and a pair of interdigitated electrodes extending over the surface of the piezoelectric layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will emerge from the detailed description which follows, with reference to the appended drawings, in which:

CLAIMS

1. A process for fabricating a substrate for a radiofrequency device by joining a piezoelectric layer to a carrier substrate by way of an electrically insulating layer, the piezoelectric layer having a rough surface having a roughness between 0.3 and 5 μm RMS at its interface with the electrically insulating layer, said process being characterized in that it comprises the following steps:

- providing a piezoelectric substrate having a rough surface having a roughness between 0.3 and 5 μm RMS suitable for reflecting a radiofrequency wave,
- depositing a dielectric layer on the rough surface of the piezoelectric substrate,
- providing a carrier substrate,
- depositing a photo-polymerizable adhesive layer on the carrier substrate,
- bonding the piezoelectric substrate to the carrier substrate by way of the dielectric layer and of the adhesive layer, in order to form an assembled substrate,
- irradiating the assembled substrate with a light flux in order to polymerize the adhesive layer, said adhesive layer and the dielectric layer together forming the electrically insulating layer.

2. The process as claimed in claim 1, wherein the dielectric layer comprises a layer of silicon oxide, a layer of silicon nitride, a layer comprising a combination of silicon nitride and oxide, and/or a superposition of at least a layer of silicon oxide and of a layer of silicon nitride that is deposited on the piezoelectric substrate by plasma-enhanced chemical vapor deposition.

3. The process as claimed in claim 1, wherein the dielectric layer is a glass layer deposited by spin-coating on the piezoelectric substrate.

4. The process as claimed in any one of the preceding claims, wherein the thickness of the photo-polymerizable adhesive layer is comprised between 2 μm and 8 μm.

5. The process as claimed in any one of the preceding claims, wherein the photo-polymerizable adhesive layer is deposited by spin-coating.

6. The process as claimed in any one of the preceding claims, wherein the bonding step is carried out at a temperature comprised between 20 and 50°C, and preferably between 20°C and 30°C.

7. The process as claimed in any one of the preceding claims, wherein the light flux is applied through the piezoelectric substrate.

8. The process as claimed in any one of the preceding claims, wherein the irradiation is pulsed.

9. The process as claimed in any one of the preceding claims, wherein the light flux has a wavelength comprised between 320 nm and 365 nm.

10. The process as claimed in any one of the preceding claims, wherein the carrier substrate is made of a material possessing a coefficient of thermal expansion lower than that of the material from which the piezoelectric substrate is made.

11. The process as claimed in any one of the preceding claims, wherein the carrier substrate is made of silicon, of sapphire, or polycrystalline aluminum nitride (AlN), or of gallium arsenide (GaAs).

12. The process as claimed in any one of the preceding claims, furthermore comprising, after the polymerization of the adhesive layer, a step of thinning the piezoelectric substrate so as to transfer, to the carrier substrate, a piezoelectric layer of a defined thickness.

13. The process as claimed in claim 12, wherein said thinning step comprises etching and/or chemical-mechanical polishing.

14. The process as claimed in either of claims 12 and 13, comprising, after the thinning step, carrying out an anneal to smooth the piezoelectric layer.

15. The process as claimed in any one of the preceding claims, wherein each step subsequent to the bonding is carried out at a temperature lower than or equal to 300°C.

16. A process for fabricating a radiofrequency filter, comprising:

- fabricating a substrate using the process as claimed in any one of the preceding claims,
- forming a pair of interdigitated electrodes on the surface of the piezoelectric layer of said substrate.

17. A radiofrequency-device substrate comprising, in succession, a carrier substrate, an electrically insulating layer and a piezoelectric layer having, at its interface with the electrically insulating layer, a rough surface having a roughness between 0.3 and 5 μm RMS suitable for reflecting a radiofrequency wave, the electrically insulating layer comprising, in

succession, from the carrier substrate to the piezoelectric layer, a polymerized adhesive layer and a dielectric layer.

18. A radiofrequency filter comprising a substrate as claimed in claim 17 and a pair of interdigitated electrodes extending over the surface of the piezoelectric layer.